LEFT-HANDEDNESS AS AN ETIOLOGICAL FACTOR IN SPEECH DEFECTS.

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Left-handedness has for centuries been one of the peculiar characteristics of humankind that have led men to make conjectures as to its "why and wherefore." A similar cause for wonder pushed its way into our thinking when it was discovered that ever and anon Nature placed a man's heart on the right side of his body. Men have sought to find a relation between these variations; they have attempted to correlate epilepsy and left-handedness; left-handedness and mental ability, and the idea, that the skilled movements of the hand are not entirely unrelated to the working of that complex mechanism of articulate speech, is not entirely new. But it may seem a wholly new, a rather fanciful hypothesis that the training of a left-handed person's right hand should evolve in him a defect of speech. Yet a consideration, first, of the anatomical background of the speech mechanism, and then of the neural representation of the fine adjustments of the right fore-arm will, we think, show a relatedness of kind and intimacy of association which makes easy ot acceptance the fact we have observed, that a forced disturbance in one of these functions is apt to make itself evident in the other.

The founder of the doctrine of phrenology is Gall. His attempt to materialize and localize psychic processes was declared by the Paris Academy of Sciences to be erroneous. Gall's deductions that the convolutions of the hemispheres of the great brain ought to be recognized as the parts where the instincts, feelings, thoughts, talents, the affective qualities and the moral and intellectual forces are exercised, were quite sound; but, unfortunately, his imagination led him into speculation of hypotheses unsupported by facts. After great controversies his theories were soon forgotten.

In 1825, for the first time in the history of medicine, Bouillaud attempted to determine a localization within the brain for the center of speech. His *"principle legislateur de la parole"* (the localization of speech), was however not acknowledged by his contemporaries, although he based his theories on cases in which speech had been affected during life and in which after death the frontal lobes were found to be injured. In 1836, Marc Dax, a French physician, reported before a meeting of physicians at Montpelier, the results of his investigations in eighteen hundred cases of hemiplegia of the right half of the body with accompanying disturbances of speech.

This observation led to the establishment of a most important fact in connection with speech, namely, that right-handed people use the left hemisphere of the brain in speech.

In 1861, Broca revolutionized our conceptions of the function of speech by localizing it within the third and second convolution of the frontal lobe. Ever since that time this region has been called "Broca's speech center." Broca, in 1862, explained the localization of the speech center in the left hemisphere by the preponderance of right-handedness in the human race. His theory was, however, apparently contradicted by the discovery that speech disturbances occurred also in cases of left-sided hemiplegia. Upon closer examination the interesting fact was revealed that these cases of left-sided hemiplegia with speech disturbances were left-handed people. Postmortem examination of such cases as published, for instance, by Pyr Smith, Hughlings Jackson, and John Ogle, showed that the lesion was within the third and second convolution of the right frontal lobe. Broca brought these newly discovered facts into accord with his theory by explaining that in the left-handed person the speech center is located in the right hemisphere. The preponderance of right-handedness in the human race was evidently in accordance with the presumption of the localization of the speech center within the left hemisphere. But direct evidence was not at hand until 1870, when Fritsch and Hitzig began their experiments of stimulating the cerebral cortex with an electrical current and showed conclusively that stimulation of one cerebrum produced coördinated movements in the opposite side of the body.

In 1874, Wernicke published his work which distinguished a sensory speech center in the temporal lobe of the left hemisphere at the same time accepting Broca's center as the correct location of the motor speech functions. In the recent work of P. Marie[2] the position is taken that in all speech disorders the actual injuries always extend beyond the limits of Broca's speech center, and that the assignment of special speech functions to this area is entirely unjustified. We have the further confusing evidence of a case reported by Lewandowsky,[3] of a thoroughly right-handed person who, at autopsy, was found to have a tumor in the right centrum ovale, and still presented an aphasia and a right-sided apraxia. Professor Ernest Jones, who refers to the case, remarks: "From this careful description it would seem that in the future the possibility must be accepted of the speech and purposeful movements being localized in the right hemisphere even although the person is right-handed."

While the problem of the localization of cerebral function is still comparatively young and as yet unsettled, much progress has been made. The situation is well stated by a recent author:[4] "There seems, therefore, on the whole, to be good ground for retaining Broca's speech center, while relieving it of part of its supposed duties. It is probable that the rearmost part of the third frontal gyre (Wernicke's area), in the left hemisphere, is intimately connected with the adjoining part of the precentral gyre, from which issues the motor pathway to the muscles of speech. Also, there is good evidence that the Broca region is the most vulnerable part of the cortex, as regards the motor coördination of speech. A writing center in the second frontal gyre, in close proximity to the motor area for the hand, has been asserted as the teaching of a few strikingly positive cases; but the negative and mixed cases have sufficient weight to prevent a general acceptance of this localization. Indeed, the entire cerebrum would seem to be, of necessity, involved in man's linguistic attainments and uses."

The localization of the speech centers, then, seems to be well established; their situation in the cerebral hemisphere corresponding to the most developed side of the body seems to be the rare exception; and the proximity of the speech center to the area of motor control of the arm, together with the cases where disorders have appeared in these functions simultaneously, lends itself, on the anatomical side, to the hypothesis that there is an intimate connection between the localized areas for speech and the highly refined motor coördinations of the right arm.

As regards the fact that the left hemisphere is the seat of direction for the majority of these skilled movements, there is little information of an *etiological* character. We may distinguish between the general lines of evidence as they attempt to explain the phenomenon from an evolutionary or functional point of view or as they seek for some more direct explanation in the anatomical structure of the human being. The phenomenon in itself is an interesting one. As E. T. Brewster[5] has expressed it: "Dexterity then, on either side of the body, is a universal and peculiar human quality, as characteristic of our species as laughter, speech, reason, the ability to use tools or to walk on the hind-legs. In fact, considering that parrots and jackdaws talk, that bears and apes walk erect, while if horses do not laugh, dogs do sometimes smile, and that it is about equally difficult to prove that some animals do not reason as that some men do, one might even go so far as to say that this universal and peculiar uneven-handedness is the only certain test of humanity." And while it is quite remarkable that one cerebral hemisphere should have been called upon to preside over the movements of speech and over those of the skillful right hand we may be assured that this arrangement did not happen by chance and we may inquire what advantage tempted evolution to produce such an arrangement.

On the one hand we have such explanations as the following: "Seeing that there is no apparent anatomical reason why man, even primitive man, has chosen the right hand as the instrument of the mind, we may ask if it is an acquired useful habit to which anatomical conditions may have contributed as a coefficient. Primitive man depended largely upon gesture language, and the placing of the hand over the heart is universally understood to signify love and fidelity. Primitive man also protected himself from the weapons of his enemies by holding the shield in the left hand, thus covering the heart and leaving the right hand free to wield the spear. In the long procession of ages evolution has determined the right-hand specialization as being more advantageous to the progress of mankind than ambidexterity. Right-handedness is an inherited characteristic in the same sense as the power of speech."[6]

Similarly Kussmaul assumes, that although there are innervation centers for all manual acts in both hemispheres, those in the left hemisphere are more developed because right-handed persons have always used these centers.

So Gaupp considers right-handedness a specific characteristic of the human race; he believes that the asymmetry of the human body shows itself not only in right-handedness, but also in other parts of the body. He points out that this asymmetry is not a disadvantage; but is, on the contrary, in most intimate connection with the advantages we enjoy. He says, "perhaps symmetry was the sacrifice Nature had to make to bestow upon the human race, other, richer assets."

M. Meyer makes a similar observation. He explains the apparent physiological discrepancy of right-handedness by the evolution of the human race. Animals are ambidextrous in contradistinction to mankind, and human culture has brought about this one-handedness.

As opposed to these theories, there have been several explanations set forth based on peculiarity of anatomical structure. According to Broca[7] the left hemisphere of the brain is usually developed earlier than the right and thus the right extremities are involuntarily preferred for muscular activities.

William Ogle lays stress upon the following organic features in explaining the prevalence of right-handedness: From an examination of a number of brains he points out greater weight and greater specific gravity for the left hemisphere; that the left hemisphere is richer in convolutions and is sooner developed in the foetus than the right one, and finally it is more richly supplied with blood, the "carotis communis" of the left side being usually larger than the right one. But Dr. Cunningham[8] shows good experimental evidence to disprove greater blood supply to the left cerebral hemisphere and states that Braune in an examination of ninety-two brains found that in fifty-two the right hemisphere was heavier; and having cited evidence unfavorable to the theory of greater richness and complexity of convolutions in the left cerebral hemisphere, and against an earlier development of it he turns to a restatement of the theory set forth by Buchanan[9] in 1862. The explanation is based upon the mechanical advantage of the right side. Owing to the superiority of the right lung as a more stable support for the right upper limb, together with the fact that the content of the abdominal cavity is heavier by about fifteen ounces, on the right side, thus displacing the center of gravity to the right of the mesial plane, there is, he says, a considerable mechanical advantage for the right limbs more than for the left.

The latest and perhaps the most interesting explanation of left-handedness based on a structural peculiarity is that set forth by Stevens and Ducasse.[10] The conclusions arrived at are substantiated by considerable data of an experimental nature obtained from a study of peripheral vision. They are as follows: "By reason of the fact of a marked difference in the space sense of the two halves of the retina, those objects in the right half of the field of vision, by appearing larger, attract the visual attention which in turn leads to grasping movements of the right hand. The hand thus favored by earliest experience acquires a special skill which causes it to be used in all manual acts requiring the greatest precision. This over-estimation occurs in the left half of the retina in both eyes and is due to some anatomical peculiarity which this half of the retina acquires by virtue of its connection with the left hemisphere of the brain." We see no *a priori* reason why this peculiarity of the retina should not be treated as an explanation of the greater development of the left hemisphere just as the greater use of the right hand has been used to explain it. We would like to suggest, however, that the theory would become more conclusive if it were found that this peculiarity were reversed in left-handed persons.

So much for the etiology of left-handedness. It has been thought to be a habit, a result of training, and when one reflects on the fact that the child is usually ambidextral until the thirteenth month,[11] the theory carries some plausibility. Prof. Meyer[12] thinks, and apparently not without good reason, that the infant is usually left-handed. However, this last question may be settled the evidence is too great against the proposition that the child becomes right-handed as a result of education. For on the other hand it has been shown that left-handedness and consequently right-handedness is an inherited character and on the other that right-handedness appears among savages where civilization and custom have not been dictators, where Nature has been the only instructor. This preponderance of right-handedness is not new, it seems to have been the condition quite as far back as the history of man takes us. On this last point after reviewing the work of numerous eminent anthropologists we have searched this characteristic out of the dim past, from the engravings of prehistoric man, from the fashion of his weapons, and from the remnants of his skeleton, Dr. Cunningham remarks: "It is easy to prove that this characteristic is one of vast antiquity. Of this there is the clearest evidence not only in historical records and pictorial representations but also in ancient mythology and in the structure of all languages. So far back then as history takes us right-handedness would appear to have been a common birthright of mankind."

These two general lines of evidence we must insist upon as established, namely, that the unisidedness of man is more than a habit, and that there is some basis in the anatomical structure of the brain to account for, at least make possible, an intimate connection between the skilled movements of speech and those of the dextral hand. Whether we accept any of the theories of righthandedness that have been set forth or whether we leave this secret of man's unisided way among the mysteries yet before science to solve, we must recognize in the human preference for the right hand the same sort of structural basis as we have accepted for his capacity of speech. It may well be that in one case as in the other it takes education to bring this latent capacity to fruition but the evidence is quite as good for right-handedness as for speech that every normal child is born with the quality fixed in the complexity of his brain and nervous mechanism. Just how close the association is between these two complicated functions, it is evident that we do not know. We do know, however, that the seat of control of both is located in the same hemisphere; we know too that the area which controls the movements of the hand in writing is in close proximity to that which regulates the movements of speech. On the functional side we are aware of the fact that there are those among us who seem to express themselves more adequately with their hands than with their speech organs, and Miss A. Wyczoikowska[13] cites some experimental evidence to show a direct connection between the movements of the thumb and forefinger and those of the tongue. We shall proceed, then, on the assumption that when we attempt to show that forcing the left hand to give up its natural functions may produce a defect in the mechanism of speech, we are not dealing with some mystical relation outside the casual sequence.

That many left-handed children are sufferers from speech defects is well known, and it has usually been supposed that the defect was a necessary consequence or accompaniment of the variation. Statistics about speech defects of the left-handed were gathered by Bolk and Lueddekens;[14] the latter found an anomaly of speech in 24 per cent of the left-handed children of normal mental qualities; in those of mediocre, 35 per cent, and in those of lower mental qualities, 44 per cent. In fact, in almost one-half of the left-handed children he found anomalies of speech.

The fact that among our manifold cases of speech defect, left-handedness was met with quite frequently, induced us to undertake the problem of finding out whether or not left-handedness may be considered an etiological factor in speech defects. During the last few months we have carefully looked into the histories of the stutterers and stammerers of the neurological department of the Vanderbilt Clinic, in order to find out whether they were, or had been, left-handed.

To such patients of the clinic as could not be interviewed personally, double postcards were sent with the request that the following three questions be answered: (1) Are you left-handed? (2) If not, were you left-handed before you became right-handed? (3) Are or were any members of your family left-handed? If so, do or did they have any speech defect?

There were many interesting replies to our three questions, but space forbids mentioning more than two. One says, in answer to the first question: "While not wholly left-handed I have some of its peculiarities. In baseball, while I bat the ball from right to left, yet I hold the bat cross-handed, that is, to bat the ball from left to right. When toeing the mark for running I advance my left foot first. I always put my left shoe on first. My left eye is stronger than my right." Another says, in answer to the same question: "Yes, that is for some things, ambidextrous as a result of forced training." In answer to the second question the same patient replies: "No, but always left-handed in dealing cards." In reply to the third question this patient answers: "My maternal great-grandmother was left-handed."

Our investigation of 500 cases of speech defect shows that 25 per cent are or were either left-handed themselves, or some member of their family shows this interesting feature. Seventeen and one-half per cent remained left-handed or returned to the left-handedness notwithstanding the endeavor of both parents and teachers to make them right-handed. Eight per cent were left-handed before they became right-handed and of these 1.5 per cent are ambidextral. Left-handed heredity was met with in 24 per cent. Some more recent work has convinced us that these figures are conservative. The special speech defect in 92 per cent of the cases quoted is stuttering, while the other 8 per cent are lispers.

The prevalence of left-handedness among persons otherwise normal Dr. Ernst[15] found to be 3.7 per cent among boys and 4.8 per cent among girls. Of 2,000 subjects tested by Dr. Ogle,[16] 85 or 4.5 per cent were found to be left-handed; of the 85, twelve had a left-handed parent; and of 57 there were 27 who knew of a left-handed relative. He also found left-handedness to be twice as common among men as among women. Hyrtle[17] estimates the amount of left-handedness at 2 per cent; Brinton,[18] 2 to 4 per cent; Hasse and Dehner examined 5,141 individuals and found only 1 per cent of left-handedness.

We are not unaware of the criticism which may be suggested to discredit any inference drawn from the relatively high per cent of left-handedness found among persons suffering from speech defects. That is, it may be suggested, that left-handedness may be correlated in general with neurotic tendencies which in turn may be a favorable soil for the development of speech defects. Indeed, Vallin[19] has shown left-handedness to be more prevalent among epileptics than among normal subjects. Smedley[20] states that dull pupils are more nearly ambidextral than average, and average pupils more than bright pupils. H. E. Jordan[21] places the per cent of left-handedness for normal persons at 2 per cent; among lunatics, at 5 to 8 per cent; among criminals at 22 per cent; he also states that sinistry is more prevalent in the lower strata of society, that it is more often met with among savages than negroes, and more often among negroes than whites. Though all statistics do not agree with the tendency here shown to find a positive correlation between left-handedness and a rather lower mentality than normal, as for instance the work of Bolton, we rather agree with the first criticism suggested but are strongly inclined to think that the average mentality of the subjects with whom we are working is, except as might be accounted for directly by the handicap in speech, as high as that of the average school child.

But as a matter of fact the large percentage of left-handedness we have noted among persons having speech defects does not become strikingly significant until one considers the number of cases in which this sinistry has refused to succumb to the coercion of training. We have no statistics to offer as regards the prevalence of such cases, nor of ambidextrality or bidextrality among our subjects, as yet. We feel that a superficial investigation will not reveal the facts and in this case that the method of the questionaire is superficial for we have found that often our patients have been unconscious of the fact that they are wont to use both hands, that they are bidextral. As we have already stated, it is the exception that the left-handed person is not forced, either by custom or direct supervision, to use his right hand for movements that he would naturally make with his left hand. In many instances we have found direct evidence, both among those in whom the training of the right hand has been permanent and among those who have returned to the use of the left hand, that they were naturally left-handed. We are inclined to think that in many cases the training was begun so early as to obscure this natural tendency.

In order not to be obliged to depend upon such unreliable information, we are attempting to find out for ourselves whether the patient is left-handed or right-handed. Our experiments follow two general lines of inquiry. To ascertain the hand used in habitual movements we have followed the tests suggested by Ewald Steer:

To detect extreme left-handedness: Eating soup, removing the stopper from a bottle, turning a coffee grinder, writing.

To detect a moderate degree of left-handedness: (a) Involuntary or little observed movements of the hand, gesticulation in speaking; reaching out for objects; dealing cards.

(b) Voluntary, simple manual activities; throwing a stone or ball; shuffling cards; using a whip.

(c) Complicated, finer activities: threading a needle; peeling potatoes or apples; cutting bread.

To determine the natural efficiency of either hand we have used three tests, of common use in the psychological laboratory, but new to our subjects involving movements more or less unfamiliar. The tapping test is described in Whipple's manual, part I, page 130. A plate of brass four inches square is placed on the table before the subject. He is given a tapping stylus and is seated before the table in a writing position so that his forearm rests upon the table. The only instructions given were that the subject should think of nothing else and tap the brass-plate as rapidly as possible from the signal "start" until the signal "stop." The stylus is connected by a flexible wire with an electrical counter, which is, in turn in circuit with dry batteries and the brass plate. The only other requisite for the test is a stop watch. The time given in each case was thirty seconds. Another test was made like the first in all respects except that for the brass plate was substituted a triangular board inclined 45° from the surface of the table. In each corner of the board is a hole .5 cm. in diameter, each hole being 8 cm. distant from the others. The subject was instructed to touch the bottom of the hole with the point of the stylus; the type of movement and direction of procedure was left to him. Three tests were made for each hand beginning with the right and thereafter alternating. In the following table the average for the three trials with each hand is given. The third test was the familiar measurement of the strength of grip by the dynamometer. We do not think that the absolute records here given are comparable with those where the Smedley instrument has been used for our dynamometer was of the simple oval type and non-adjustable. The index of dextrality, that is, the superiority of one hand over the other, is, however, directly comparable with other results. The subjects were picked at random from the clinic. There happened to be in the group one left-handed girl and three boys who considered themselves ambidextral. The small number of subjects, sixteen, tends to make the results inconclusive; we publish them as they tend to be expressive of the progress of the work so far as it has gone. Three tests were made with the dynamometer for each hand; only the best record is given. Of the sixteen subjects, fourteen were stutterers and two were lispers:

In the table I stands for index of dextrality, obtained dividing the record of the left hand by that of the right.

The results here hardly warrant any interpretation. Attention may, however, be called to the fact that nine of the sixteen subjects did better in the dynamometer test. The only subject who excelled with the left hand in the three hole tapping test was the avowed left-handed person. In the tapping test only two did better with the left hand, and both of these stated that they were right-handed in all respects. Why the tendency to left-handedness should appear in the measurement of the strength of grip and not noticeably in the tapping test is rather obscure. If the results of our further investigations should confirm the tendencies here indicated, we might infer that the greater success in the tapping tests with the right hand was due to training, while the records of the dynamometer more nearly express the natural undeveloped capacity. As regards the index of dextrality with the dynamometer, Whipple places it between 91 and 96 per cent; Smedley, from 82 at the age of nine, to .89 at the age of eighteen; Wallin, for epileptics at 1.5 per cent.

Subject:	Age:	Sex:	Tapping:			Three Hole Test:			Dynamometer			Hand Prefer.
			R.	L.	I.	R.	L.	I.	R.	L.	I.	
W.S.	17	M.	141	60	.43	43	39	.9	39	35	.9	R.
H.S.	16	M.	151	142	.94	53	45	.84	30	37	1.23	B.
R.G.	12	M.	171	177	1.03	43	38	.88	22	23	1.04	R.
J.N.	12	M.	165	137	.83	48	31	.65	19	12	.63	R.
Y.S.	13	F.	171	138	.8	39	36	.92	14	16	1.14	R.
S.H.	20	M.	127	112	.88	44	43	.98	36	33	.92	B.
M.W.	18	F.	162	157	.97	26	28	1.08	11	13	1.2	L.
S.B.	21	F.	144	147	1.02	46	35	.76	14	15	1.1	R.
M.R.	16	F.	132	109	.83	43	36	.84	16	19	1.2	R.
A.G.	14	F.	160	143	.19	42	35	.83	20	18	.9	R.
F.E.	16	F.	137	132	.96	42	32	.76	17	18	1.06	R.
A.W.	20	F.	140	123	.88	37	28	.76	20	25	1.2	R.
C H.	18	M.	161	110	.73	43	35	.81	35	31	.9	R.
R.C.	15	M.	134	123	.92	45	40	.89	21	20	.95	R.
L.D.	15	M.	144	134	.93	36	31	.86	18	21	1.17	R.
					Av. .76			Av. .86			Av. 1.03	

The evidence that training the right hand of the left-handed child produces a speech defect must be more or less inconclusive for there will always be an abundance of negative cases. But the fact is before us that many times the speech defect appears simultaneously with the correction of the left hand at a time when the child's speech has become well established and there is some evidence to show that the defect disappears with the return to the use of the left hand. Dr. Whipple[22] calls attention to three cases where the casual relation seems well enough established. He says: "My attention has been called to a case of left-handedness in a boy about eight years old and in the third grade. His teacher tried to compel him to use his right hand in various school exercises, with the result, apparently, that a speech defect nearly equivalent to stammering, appeared." He cites another case of a little girl whose development seemed normal until about a year and a half old, when an attempt to convert her left-handedness resulted in her ceasing to talk. When given liberty to use her left hand again freely she began to talk. The third case concerns a young man of twenty, afflicted with word-blindness and stuttering, who was cured by reversing the "hand."

When we began our study of these cases we were unaware that anyone else had noticed a relation between these two conditions. Among the left-handed patients who had come to us for training we found a number whose speech defect appeared at about the same time that they were forced to change the dextral hand. This led us to inquire further and though oftentimes it has been very difficult to ascertain at just what time the speech anomaly made its appearance or just when the education of the right hand began, we have been able to find some twenty cases which seem to us clearly indicative of the interaction of these two motor coördinations. Four of these cases are represented in the tests. The evidence is not so clear as in the cases cited by Whipple, for while the speech difficulty seems to have occurred as a result of the forced training of the right hand, we have not found that where a return to the use of the left has occurred that the difficulty disappeared. The evidence we have gathered was obtained from the persons or from their parents. We quote the following, a voluntary retrospection of S. H. as he was doing the tests, as typical of the information we obtained: "When I was six or seven years old I began to stutter when talking to my teacher. She made me use my right hand and hit my left one every time she saw me use it. But every time she turned her back I used my left again and so now I write with my right hand and every little movement I make with my right, but I pitch ball with my left." We have as yet no clear evidence that a return to the use of the left hand will alleviate the difficulty of speech, but our study in this direction has not gone far enough to produce results.

In view of the multiplicity of situations which result in anomalies of speech and because it is so difficult to make a clear case for the etiological factor of left-handedness even with those patients where the evidence seems most convincing, we wish the following conclusions to be considered tentative. We hope, however, that the present data will recommend itself sufficiently to speech educators to merit consideration in the therapy of their cases.

1. The human race is peculiarly unisided. Corresponding to this unisidedness we have the development of only one speech center which is almost universally located in the hemisphere which controls the dextral hand. The association between the centers which control the movements of speech and those of the preferred hand is very intimate.

2. Left-handedness is not a habit but is due to some structural peculiarity of the cerebral hemispheres. Whatever the nature of

this peculiarity it is responsible alike for the preference of one hand and for the location of the active speech center in one hemisphere.

3. Among left-handed persons, speech defects very often appear at a time when they are forced to change their natural left-handedness into artificial right-handedness. Some evidence is to be had showing that the defect disappears when a return is made to the use of the naturally dextral hand. The hypothesis may be advocated that the task placed upon the left hemisphere in such a re-education arouses the latent speech center here and results in a conflict of the two speech centers which manifests itself in speech defects such as stuttering and lisping.

4. Left-handedness should be encouraged where it is natural. Where a speech defect has occurred under such conditions, it is advisable to order a return to the use of the left hand. We are inclined to the opinion that speech anomalies are not the only undesirable consequence of this unnatural procedure, but are more apt to appear as using the right hand for writing, an accomplishment closely allied to speech, is the most common and first connection to be made.

When custom institutes reforms of *apparent* defects which produce *real* ones, it is time that Dame Custom change her ways. Sinistry should lose its unlucky connotations; rather it should be considered the unique, the different, the rather original way, and as we strive to attain this in many respects so left-handedness might better be considered boon than ban.

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